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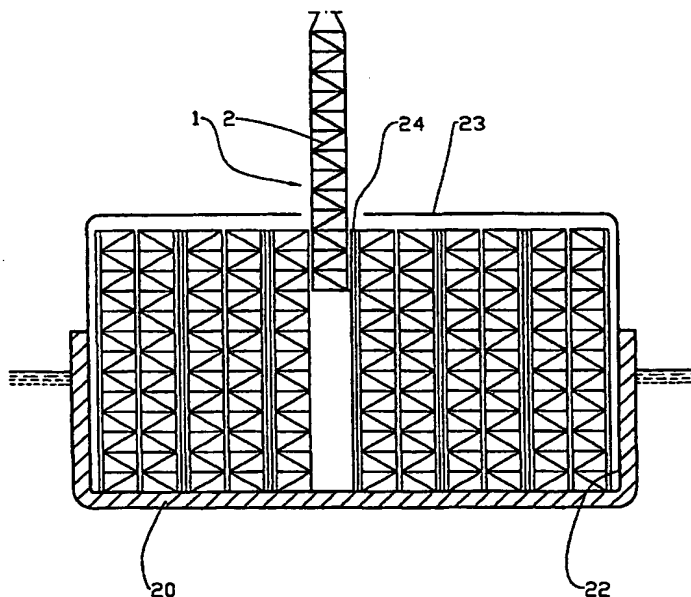
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A DEVICE AND METHOD FOR FASTENING PRESSURE VESSELS



(57) Abstract: A device for and method of fastening pressure vessels (8), particularly of the type used for sea transport of pressurised petroleum products, and where at least two pressure vessels (8) are arranged in a cassette (1).

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A DEVICE AND METHOD FOR FASTENING PRESSURE VESSELS

This invention regards fastening of pressure vessels, particularly of the type used for sea transport of pressurised petroleum products.

- 5 Sea transport of gaseous petroleum products has essentially taken place by use of the so-called Liquefied Natural Gas (LNG) method. The method comprises the cooling of gas to a liquid, whereupon the gas may be transported in ship's tanks at atmospheric pressure. The method requires considerable
10 investments both at the port of shipment and at the receiving end. As the gas must be cooled to a relatively low temperature, up to one fifth of the gas is used for running the cooling and heating processes. To consume this much energy just for the transport related processes is costly and
15 also gives rise to environmental concerns.

Several other ship based solutions have been proposed, in which the gas is pressurised and/or cooled in order to achieve a gas density that is suitable for the purpose. Such

solutions have not gained much practical use, but one solution in which a large number of vertical tubular pressure vessels are placed in the cargo hold of a ship, has attracted considerable attention. The method is termed Pressurised

5 Natural Gas - PNG. In accordance with such a method, the gas is compressed to an overpressure of a couple of hundred bar at the port of shipment, and then filled onto the pressure vessels located on the ship. The cooling is limited to simply and economically removing the heat of compression from the

10 gas, to give a transport temperature near the ambient temperature. The great disadvantage of the PNG-method is that the gas cylinders, when manufactured in accordance with known techniques, take up an excessive share of the ship's carrying capacity.

15 The object of the invention is to remedy the disadvantages of the PNG-method of transporting natural gas.

The object is achieved in accordance with the invention by the characteristics stated in the undermentioned description and in the appended claims.

20 Modern codes of construction and approval, which allow better utilization of the mechanical properties of pressure vessel materials, attach much greater importance to the documentation of material properties and construction, and also to periodic inspections of pressurised piping and tanks,

25 than that which has previously been the case.

As mentioned above, the main disadvantage of the PNG-method is the fact that the net weight of the tanks takes up an excessive share of the ship's carrying capacity. The required

reduction of the net weight of the tanks can only be achieved by using relatively high-strength materials in combination with construction and certification in accordance with the most appropriate relevant standards. In order to render possible the required periodic inspection, the pressure vessels according to the invention are arranged in relatively longitudinal vertical cassettes, in a manner such that inspection may be carried out at any time, also during the normal running of the ship.

- 10 The cassettes, which in a preferred embodiment are designed to comprise eight pressure vessels, are designed as a plate or trussed structure. The pressure vessels are connected to the cassette structure in an appropriate manner, to ensure that the net weight and thermal stresses affect the pressure vessels to the smallest possible extent. The spacing between the pressure vessels, and between the pressure vessels and the internal structure of the cassette, is sufficient to allow access for inspection equipment. Longitudinal weld seams, which normally suffer the greatest stress, may be oriented inward so as to make them immediately accessible from the central space of the cassette.

The cassettes are designed to be pre-fabricated, checked and certified before being positioned in the cargo hold of a ship. The forces exerted by the net weight of the cassettes and the cargo normally bear against the bottom of the ship. The cargo hold may be equipped with slides that are complementary to guides in one or more of the side walls of the cassette. Thus the cassette may be guided onto the slides, e.g. while hanging from a crane, and then lowered

into position in a controlled manner. The cassette is held in the horizontal position by the same slides/guides.

The pressure vessels in a cassette are connected to a common manifold. The manifold may be of a simple construction, as the temperature differences that will occur between the connected pressure vessels in the structure in question, will be insignificant.

The following describes a non-limiting example of a preferred embodiment illustrated in the accompanying drawings, in

10 which:

Figure 1 shows a section of a ship, where a pressure vessel cassette is being lowered into the cargo hold of the ship;

Figure 2 shows a section of the ship of figure 1, where a number of pressure vessel cassettes are arranged in the cargo hold of the ship, and where one pressure vessel cassette and one partition are shown in bold; and

Figure 3 shows a plan view of a pressure vessel cassette according to figure 2.

In the drawings, reference number 1 denotes a pressure vessel cassette comprising a load-bearing trussed structure 2 with guides 4 and required fastening elements 6 for support of eight longitudinal pressure vessels 8 of a type that is known per se. The pressure vessels 8 are equipped with separate connections 10 to a common manifold 12, which in turn is connected to the ship's loading/unloading pipe 14 via a

connector 16. The fastening elements 6 may be of any appropriate construction that meets the requirements for a steady connection to the cassette 1, maximum relief of the weight of the pressure vessel 8, and a fixed position
5 relative to the manifold 12.

The cargo hold 22 of the ship 20 is provided with bulkheads 24 equipped with slides 26. The guides 4 of the cassette 1 fit the slides 26 in a complementary manner, and the guides 4 are designed to be displaced vertically along the slides 26
10 during loading of the cassettes 1. The slides 26 are also designed to take up horizontal forces from the cassettes 1. The cargo hold 22 of the ship 20 may be provided with hatches and/or a superstructure 23.

The pressure vessels 8 are located along the inside of the
15 trussed structure 2 of the cassette 1. Centrally in the cassette 1 there is a longitudinal space 30 arranged so as to allow inspection access to the pressure vessels 8. The longitudinal welds 9 of the pressure vessels 8 face in towards the space 30. The pressure vessels 8 are arranged
20 with sufficient mutual spacing and distance to the trussed structure 2 of the cassette 1 to allow inspection of the pressure vessels to be carried out through using instruments in accordance with a technique that is known *per se*, without having to remove the pressure vessel 8 from the cassette 1,
25 see figure 3.

The pressure vessels are placed in and connected to the trusswork 2 of the cassette 1 by means of fastening elements 6, prior to the cassette being loaded into the ship's 20 hold 22. The manifold 12 is also connected to the connections 10

of the pressure vessels 8 before loading, which means that all testing and certification can be performed prior to the cassettes 1 leaving the place of manufacture.

For loading into the ship's 20 hold 22, the cassettes are
5 hoisted to their vertical orientation of use and positioned over the relevant slides 26 provided in the bulkheads of the cargo hold 22. The guides 4 connected to the trussed structure 2 of the cassette 1 fit over the slides 26 in a complementary manner. After the guides 4 have been positioned
10 over the slides 26, the cassette 1 is lowered along the slides 26 until it abuts the floor of the cargo hold 22. The manifold 12 is then connected up to the ship's 20 loading/unloading pipe 14 by means of the connector 16.

Using the pressure vessel cassette 1 according to the
15 invention will, when compared with prior art, to a significant degree simplify manufacture, inspection and documentation of the type of pressure vessel 8 in question.

C l a i m s

1. A device for fastening pressure vessels (8), particularly of the type used for sea transport of pressurised petroleum products,
5 c h a r a c t e r i s e d i n that at least two interconnected pressure vessels (8) are arranged in a cassette (1).
2. A device in accordance with Claim 1,
c h a r a c t e r i s e d i n that the pressure
10 vessels (8) are connected to the cassette (1) via at least one fastening element (6).
3. A device in accordance with one or more of the preceding claims, c h a r a c t e r i s e d i n that the
cassette (1) is slidingly connected to the bulkhead (24)
15 of a ship (20) and designed to rest on the floor of the ship's (20) hold (22).
4. A device in accordance with one or more of the preceding claims, c h a r a c t e r i s e d i n that a space
(30) is provided in the longitudinal direction of the
20 cassette (1), which space is designed to provide access for personnel when inspecting the pressure vessels (8).
5. Method of fastening pressure vessels (8), particularly of the type used for sea transport of pressurised petroleum products, c h a r a c t e r i s e d i n
25 that at least two pressure vessels (8) are arranged in and connected to a cassette (1) prior to placing the

cassette (1) carrying the pressure vessels (8) in question in the operative position of the cassette (1) in a ship's (20) hold (22).

5 6. A method in accordance with Claim 5,
c h a r a c t e r i s e d i n that a manifold (12) is
sealingly connected to the pressure vessels (8), and
that pressure testing is performed prior to the cassette
(1) being placed in the ship (20).

10 7. A method in accordance with Claim 5 and/or 6,
c h a r a c t e r i s e d i n that the cassette (1)
slides vertically along slides (26) by means of guides
(4) provided in the ship's (20) hold (22), whereupon the
manifold (12) is connected to the ship's 20
loading/unloading pipe (14).

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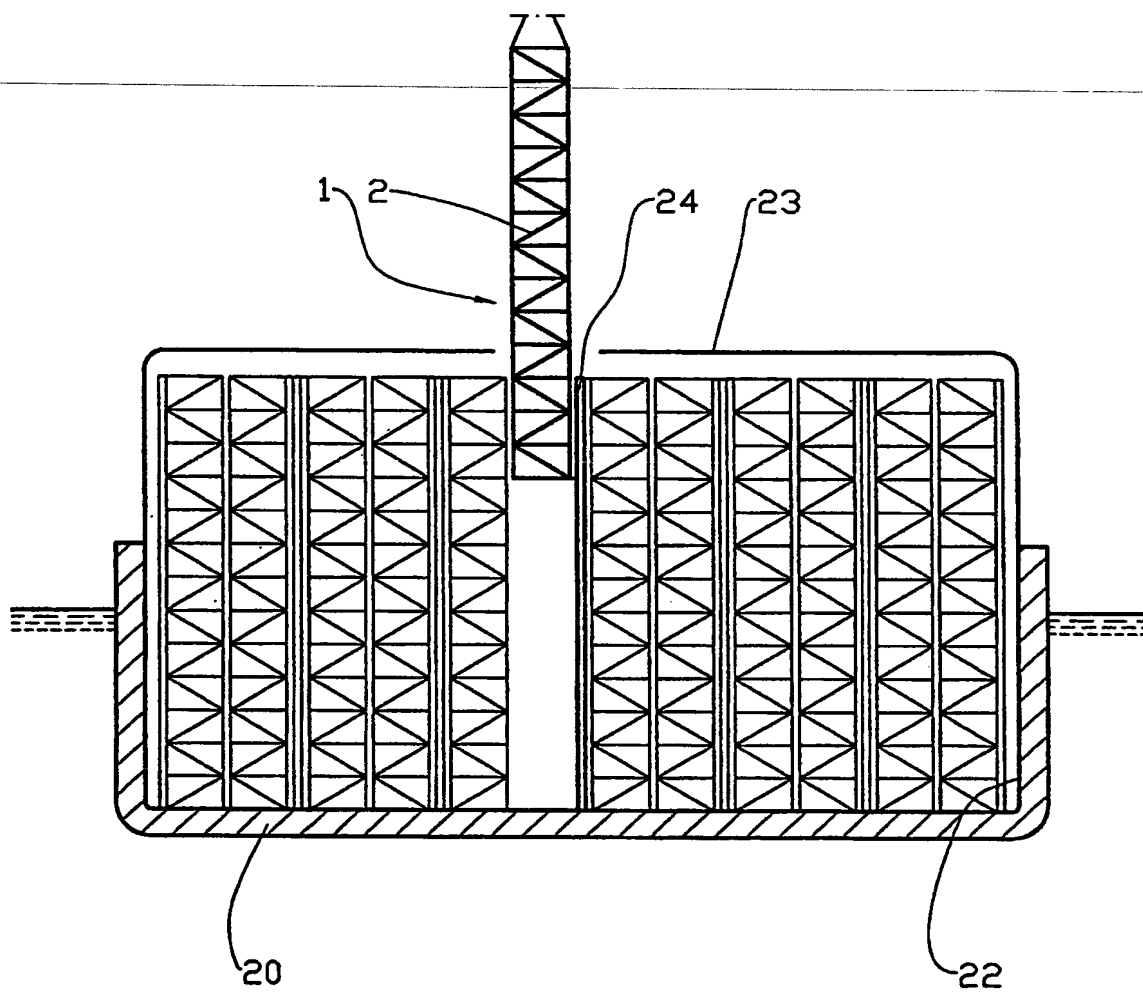


Fig. 1

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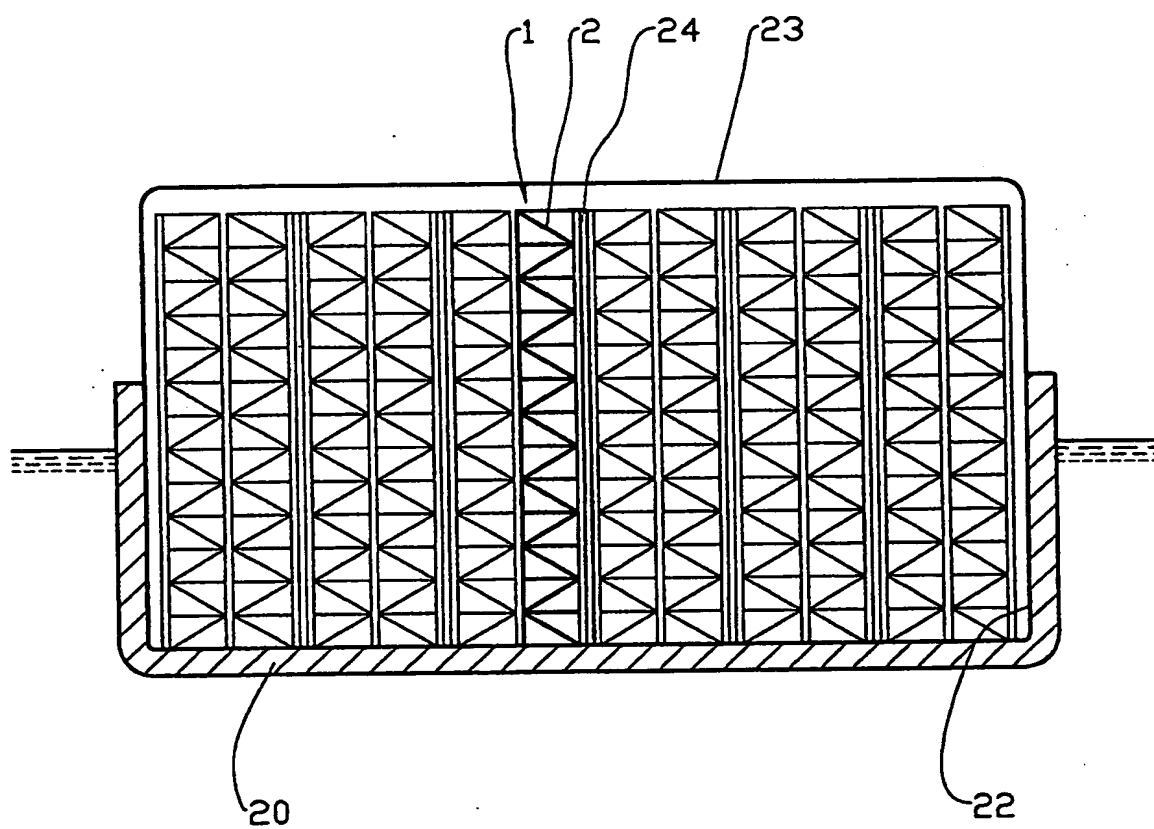


Fig. 2

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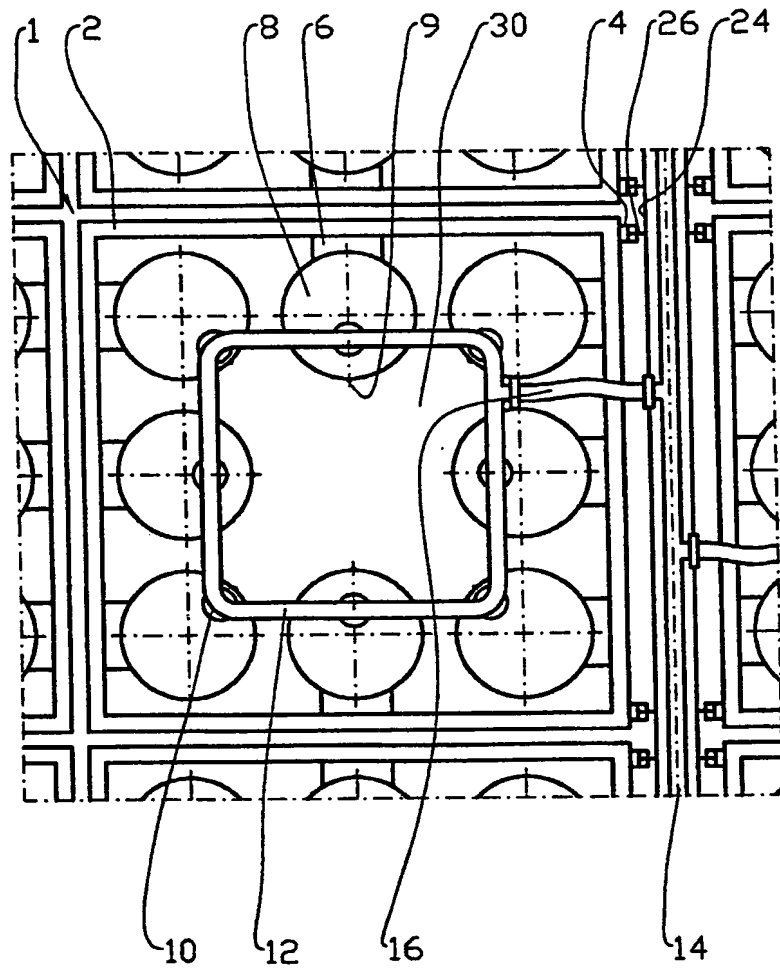


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 02/00059

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B63B 25/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5803005 A (STENNING ET AL.), 8 Sept 1998 (08.09.98), column 4, line 50 - column 5, line 14, figures 2a-3 -----	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Information on patent family members

28/01/02

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PCT/NO 02/00059

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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